Hydro-Québec

Direction Environnement

and development

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GROUP IS PROUD

TO PRESENT

THE QUALITY

SERVICES AND

EXPERTISE IT OFFERS.

The environment consists of the natural elements (earth, air and water) necessary for man's survival. But man's activities cause changes in these elements, altering the environmental balance, which depends on the relationship between nature and man. We must understand this relationship and plan and harmonize our activities accordingly, if we are to fulfil human needs yet at the same time adopt development strategies that preserve and enhance the environmental balance.

Quebec: Lake Memphrémagog area

Hydro-Québec's Environment Team

Mandate

For the past 12 years, Hydro-Québec's Environment group has been one of the driving forces in the development of environmental expertise in Canada.

Hydro-Québec has given the group the following mandate:

1. To design and carry out impact studies in accordance with government requirements.

2. To ensure the protection and enhancement of the environment during the construction, operation and maintenance of installations and equipment.

3. To research and analyse environmental resources and their interaction within ecosystems.

4. To design and conduct programs to monitor resources and environments after a project has been completed.

5. To draw up directives, standards and practices aimed at protecting and enhancing the environment while activities are taking place.

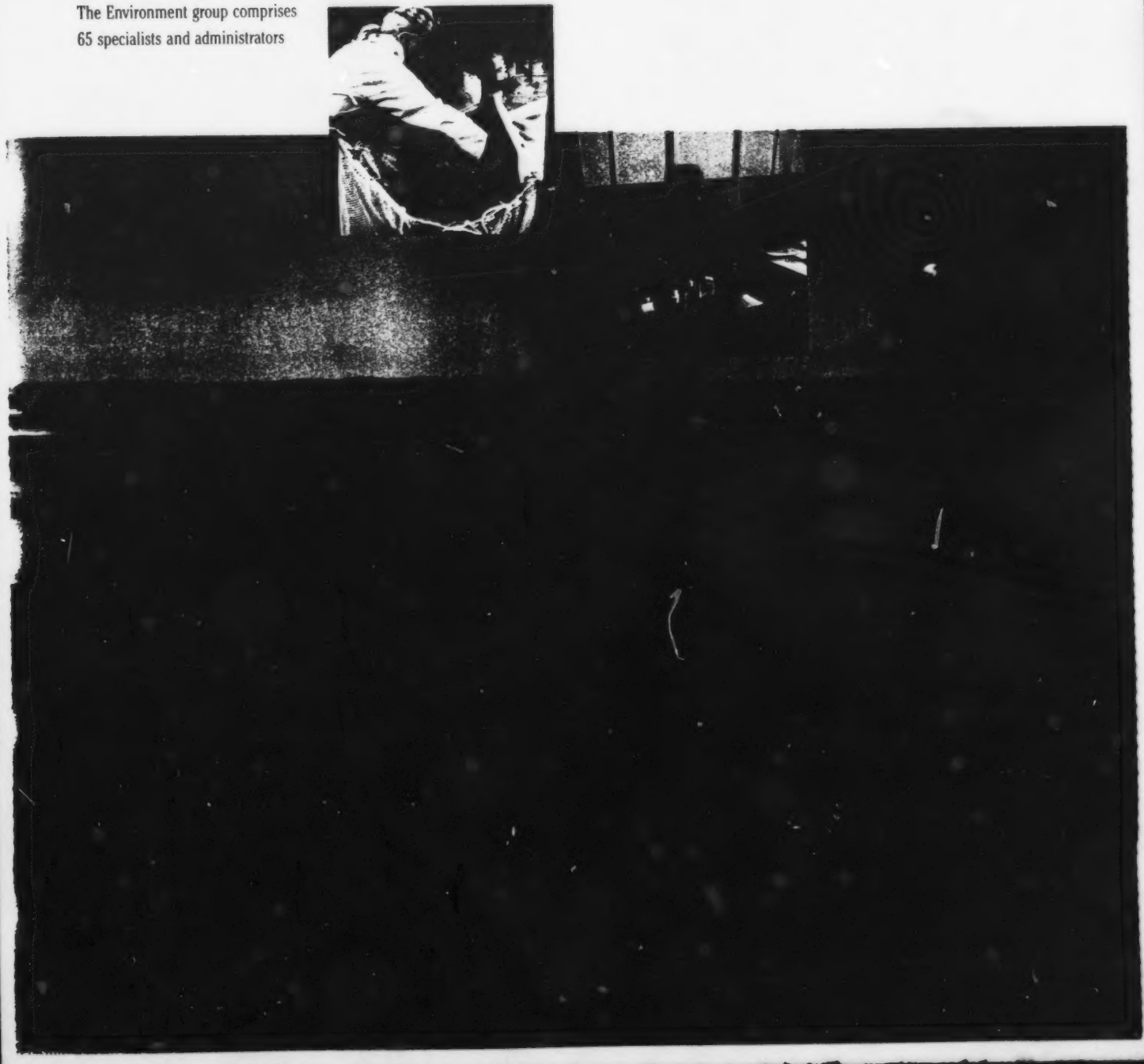
Structure

The Environment group comprises 65 specialists and administrators whose job is to coordinate and guarantee the quality of the services provided.

They perform management and supervision of contractual work, impact studies, and specific studies awarded to consultants specializing in the analysis of environmental problems and the development of environmental technologies. Each year, the Environment team administers more than one hundred contracts awarded to firms specializing in:

- impact studies
- socio-economic analyses
- laboratory work
- data processing and analysis.

The group is recognized for its expertise in the planning, design and management of environmental studies and projects.



The leading edge of science and technology

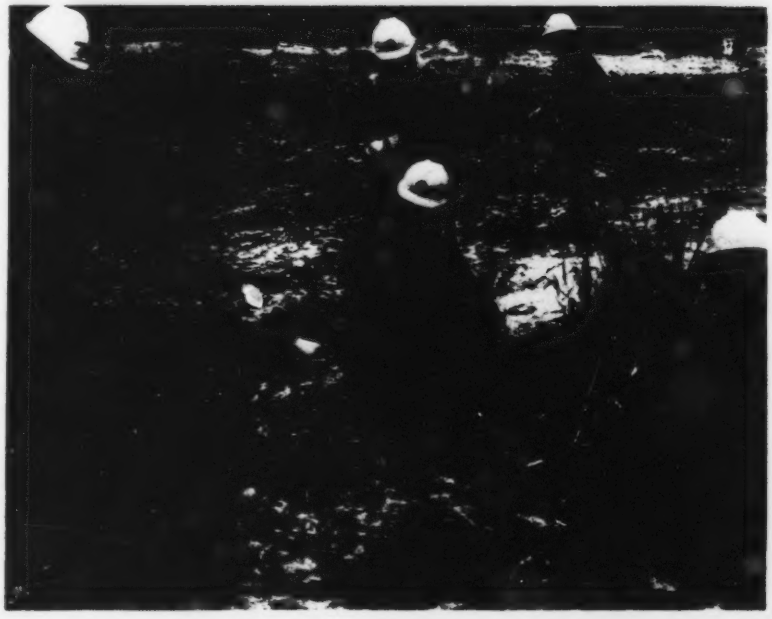
The Hydro-Québec Environment group is one of a kind: it has participated in some of the most innovative and ambitious environmental projects ever undertaken.

Its principles and methods are set out in Hydro-Québec's *Environment Policy*, in which the utility affirms its obligation to protect and enhance the environment.

State-of-the-art methods and tools

The Environment group puts its knowledge to use with the most up-to-date methods and tools.

- Location and impact studies for power lines, substations and mobile generating stations (wind turbines and thermal plants). Studies include:
  - inventories and analysis of an environment



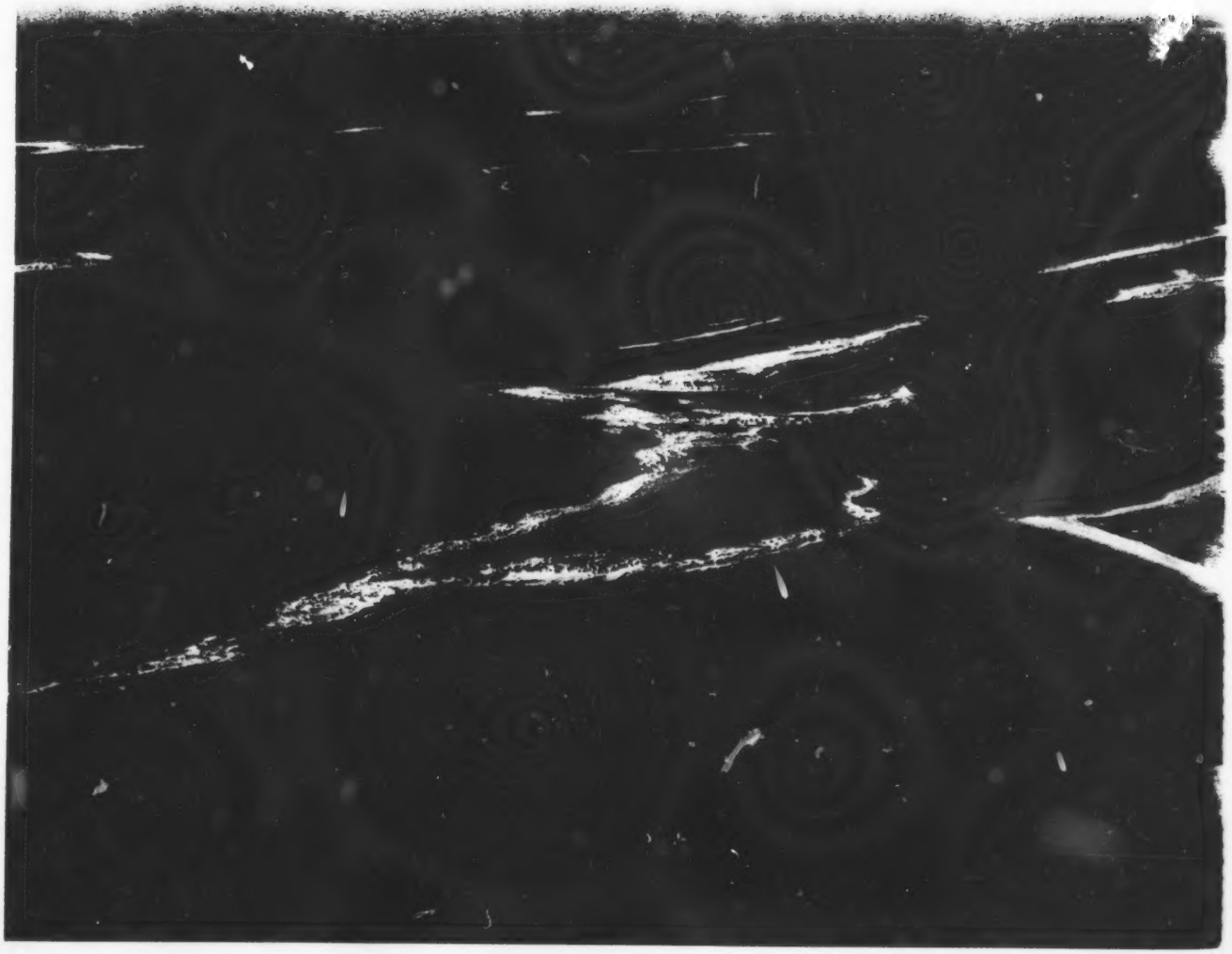
Bird's-eye view of the reservoir, spillway and power station at La Grande 3.

Restoration at the James Bay hydroelectric complex

Since 1975, 10 million alder, pine, willow, poplar and myrtle have been planted. The survival rate is excellent, and this successful seeding and planting program has enabled Hydro-Québec to develop techniques applicable to other regions of the world.

Some of the reforestation work was awarded to the local population.

Hydroelectric development project on the Grande Baleine River in Northern Québec

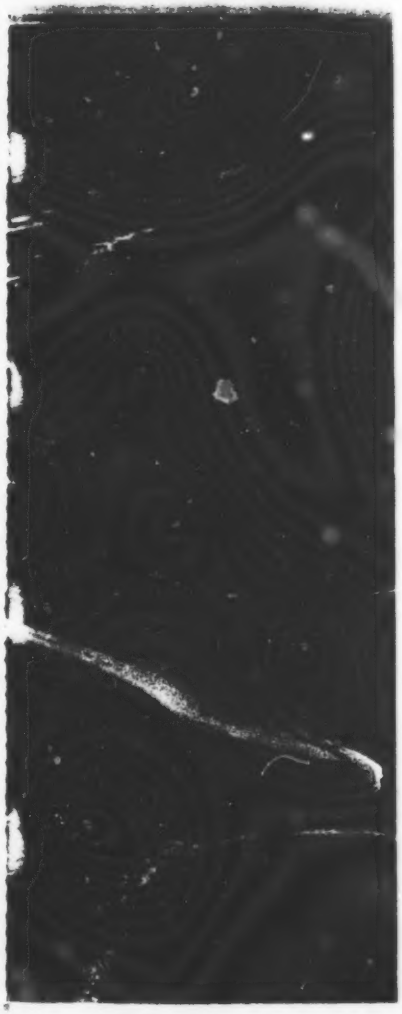


- ranking of its environmental elements
- identification and assessment of line, substation or power station alternatives
- selection and optimization of a specific alternative
- definition of impacts and mitigative measures
- location and impact study reports
- environmental monitoring during work
- environmental follow-up after completion.

• Environmental study methods for proposed dams and hydroelectric generating stations, including:

- inventories and analysis of an environment
- identification of problems, scenarios and access strategies
- development alternatives
- local, regional and national contexts
- development scenarios
- definition of impacts and mitigative measures
- impact study reports
- environmental monitoring during work
- environmental follow-up after completion.

• Computer-aided assessment: models to simulate hydrological factors, hydrodynamics, sedimentology, thermal factors, water quality, migration of a pollutant in the soil, dispersion, etc.



Socio-cultural inventories: native peoples.

- Computer-aided inventory and high-technology imaging: automated mapping and facilities management (AM/FM), visual simulation, expert systems, bathymetry using helicopter transportation, satellite images, laser topography, remote sensing, etc.

- Methods for studying the ecological value of forests: type and age of stands, sensitivity to products and activities, etc.

- Restoration analyses: identification of species able to adapt to a damaged zone (notably in order to prevent slope and riverbank erosion) using basic data such as soil type, hydrology and climate.

- Chemical or mechanical control of vegetation.

- Erosion sensitivity analyses: soil studies to find ways of preventing erosion caused by projects.

- Methods of wildlife study (salmon, beaver, caribou, white-tailed deer) focusing on habitats, fauna/habitat relations, and the ecology of dam reservoirs.

- Methods of air-quality analysis: telemetric analysis by correlation spectrometry, digital simulation of gas concentrations, performance tests, particle-emission tests, etc.

- Studies of noise and noise reduction (special analysis, acoustic propagation).

- Methods for pollution control, especially PCBs (polychlorinated biphenyls).

- Clean-up methods for pollutant spills.

- Techniques for treatment of wastewater and purification of drinking water.

- Methods for cost/benefit analyses of projects.

- Methods for social, archeological and ethnological studies.

- Methods for landscape analysis and inventory.

- Basic and thematic cartography.

- Interpretation of aerial photographs.

- Standard project schedules.

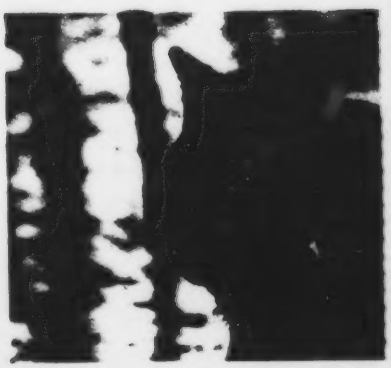
- Standard contracts and administrative procedures for efficient budgeting and management.

Proven expertise

The Environment group has a well-earned reputation. Few organizations or companies have been able to put together such a large and diversified team of specialists and consultants involved in environmental protection and enhancement, and to keep it operating for more than a decade.

Grande Baleine project: physical inventories

Protection of northern fauna and flora: marking of caribou; studies of predators and avifauna; protection of moss covering.

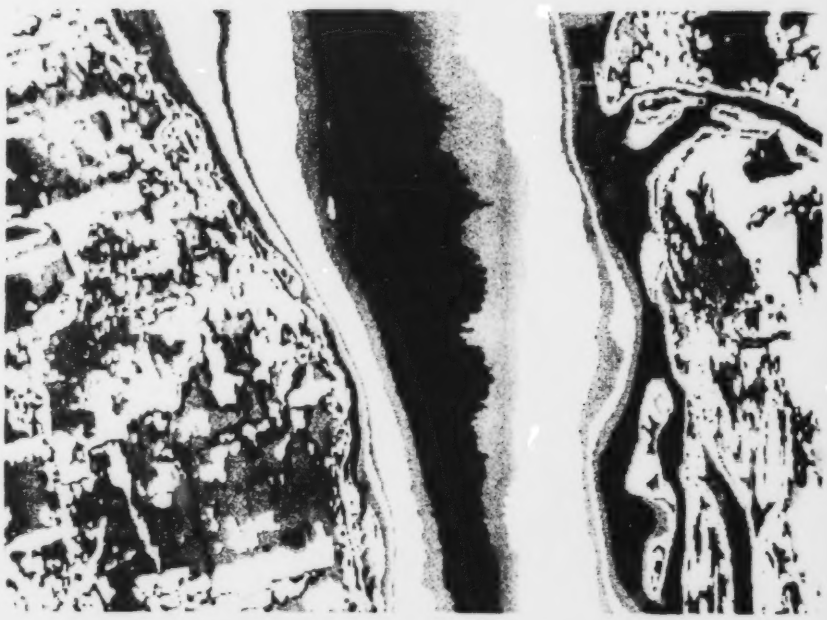


The unit continually develops its research activities. It optimizes its work tools by using an integrated approach as well as systematized, computerized methods and data. It has gained an international reputation by producing results in fields where innovation is a must. Whether for its work on the James Bay hydroelectric complexes, or for its research on salmon in the Far North, the Environment team enjoys an excellent reputation.

Furthermore, the many projects it has carried out in both inhabited and remote regions have proved its expertise in conducting and managing environmental studies.

For studies alone, the group manages an annual budget of $12 million and uses a staff of 45 specialists, as well as some 140 researchers, specialists and technicians from its partner companies. Studies are carried out according to a rigorous schedule, and the high level of methodology and analysis ensures that their results are used effectively in decision-making.

Two applications of data-processing tools



Remote sensing of Atlantic tomcod migration areas: rapid studies carried out at low cost.

Fishing village built on the ice. Thermal analysis of an infrared image of river currents.

Weir and dam of the Manic 2 power station; the Manic-Outardes complex comprises seven power stations.

Estuary of the Manicouagan.

Digital model simulating unsteady flow: first model of its kind in the world, developed by Hydro-Québec. The flow will be modified as a function of a change in the operation of the complex. The model simulates the movement of the tide on the sandbanks and shallows, as well as the mix of fresh and salt water.

TAO

FIGURE D.3 PROJET MANICOUAGAN (1986) - HYDRODYNAMIQUE
DEBIT = 500 M3/SEC, SCENARIO B
TEMPS = 6H17

The client's needs come first

The Environment group offers an integrated environmental approach based on the projects, orientations and intervention strategies of its clients.

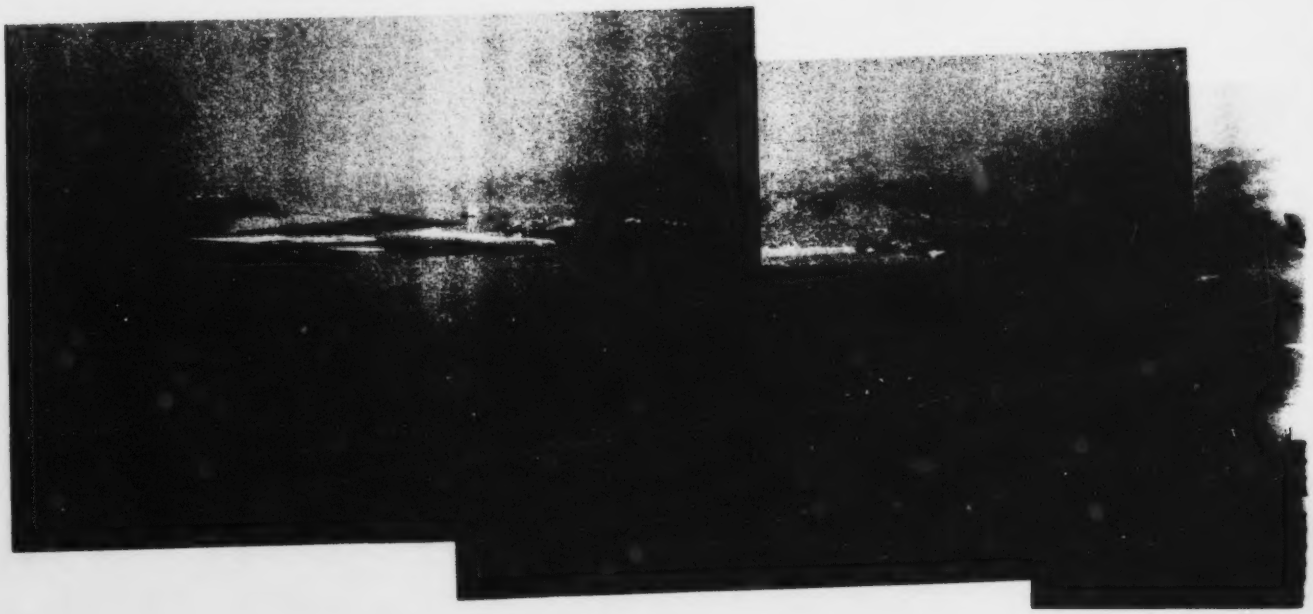
Understanding the environment

Any intervention must be founded on a thorough understanding of the environment.

The first step is a rigorous inventory and analysis of the natural and human elements. The Environment group can then provide the client with a clear image of the dynamic forces at work in the environment.

Participation in design studies for the Three Gorges complex in China

On foreign projects, the Environment team offers its services through Hydro-Québec International.



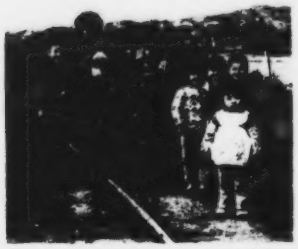
Various methods (inventory, interpretation of aerial photographs, impact analysis, computer-aided mapping assessment and modelling, measurement of sensitivity to various parameters, etc.) are used for this purpose, depending on the scope of the study requested.

Planning the development and installations

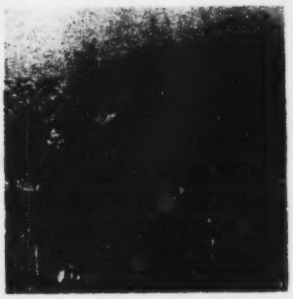
Once the elements in an environment are known, the intervention mode can be selected and planned according to the client's aims.

For example, if the client is planning to build a large dam, a reservoir and a hydroelectric generating station, the Environment team examines the local, regional and national consequences and proposes one or more development strategies based on the client's requirements and the potential for enhancing the existing resources.

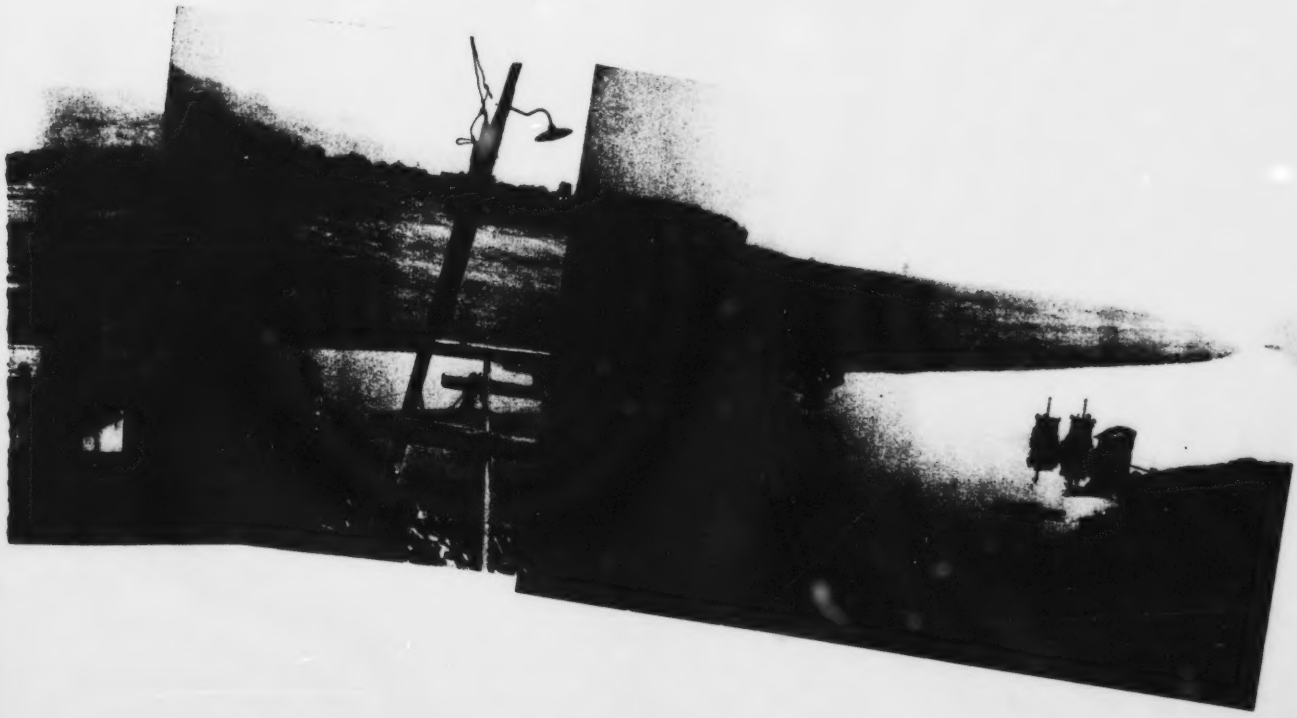
It is then possible, on the basis of the development option selected by the client, to plan the physical installations with a view to optimum integration with the environment,



An innovative approach to the study of a major river, the Yang Zi Jiang: comprehensive studies from the basin to the estuary, hydrological and sedimentological studies and studies of river traffic.



Because hundreds of thousands of inhabitants must be relocated, studies of the social and human environment, as well as the water supply, are under way.



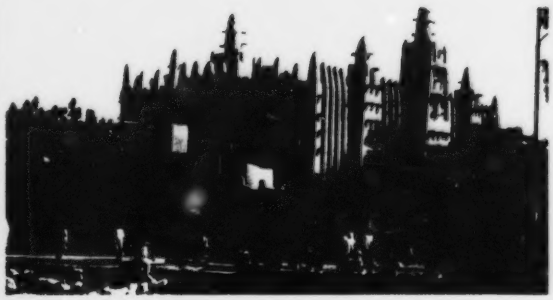
taking into account the impacts and proposed mitigative measures.

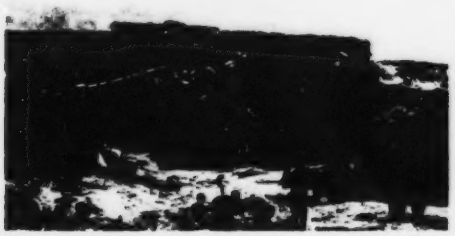
For smaller projects, the approach is basically the same: to integrate the existing and potential elements of the environment into the project specifications.

Coordination and management of studies and work

At the client's request, the group designs and carries out complete, integrated development studies.

It provides environmental expertise for planning, engineering, construction and operation – from the preliminary studies right up to the environmental monitoring program after project completion. To accomplish this, the Environment group coordinates work groups in which its expertise is put to maximum use. Moreover, its experience in collaborating with its partners (consultants, foreign experts, etc.) makes for a team that really knows how to get the job done.





Bamako-Ségou project: mitigation of the impact on the human environment

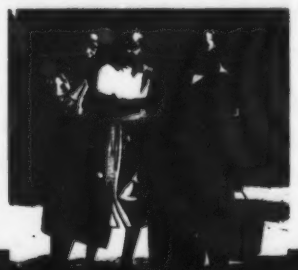
Socio-cultural inventories: protection of villages and cultural properties in Mali.

Finally, the group uses efficient management tools such as standardized contracts and administrative procedures, thus assuring the client the contractual arrangements will be respected.

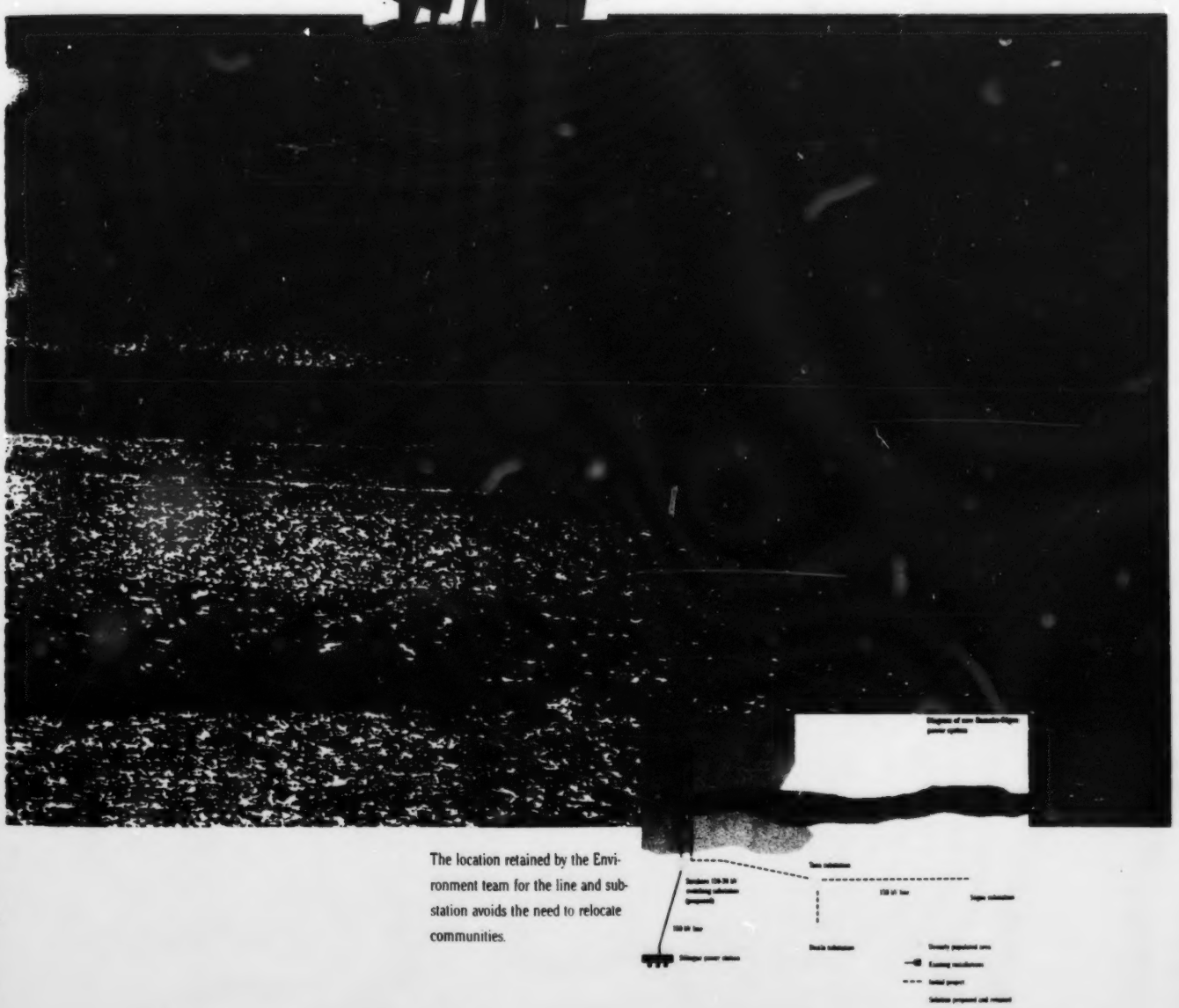
Client participation

One of the group's basic aims is to enable its clients to acquire the skills they need to meet their training and management requirements.

The Environment group believes that consulting the residents of an area to be affected is one of the keys to the harmonious integration of a project. As a result of its extensive experience with the public – urban residents, representatives of farming interests or native communities – the Environment group's ability to analyse needs makes it a dynamic participant and source of technical assistance, working in conjunction with the client.



The Niger, Mali's largest river.



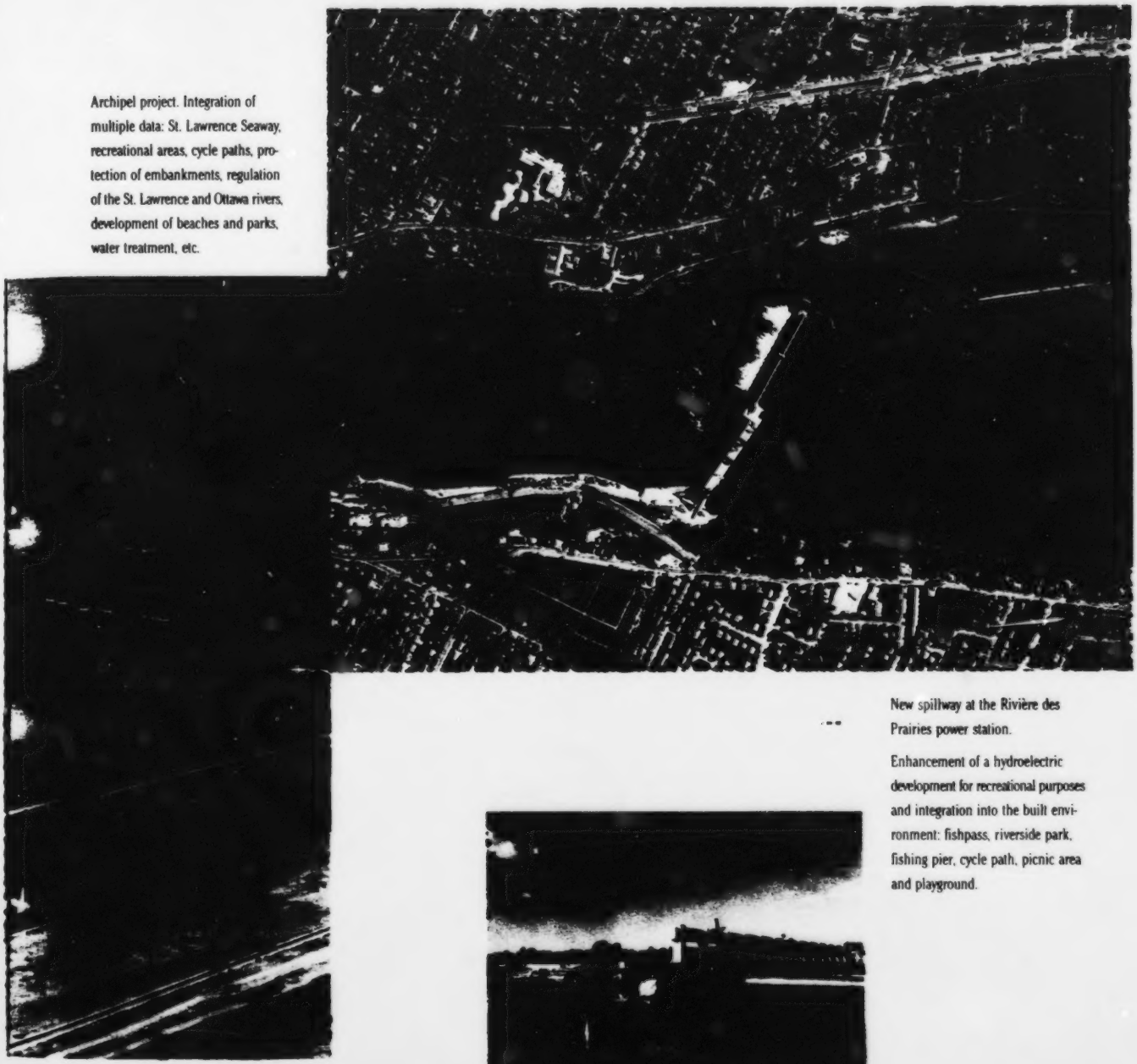
The location retained by the Environment team for the line and substation avoids the need to relocate communities.

A wide range of studies

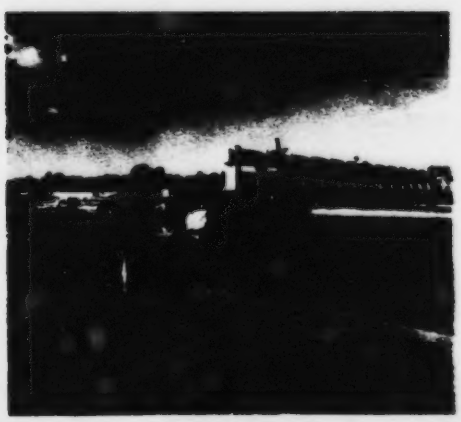
After more than a decade of activity, the Environment group is widely recognized for its skill in managing any phase of environmental studies and projects, including conception and planning, design, construction and operation.

- Hydroelectric dams and reservoirs (ecology, development)
- Hydroelectric and thermal power plants, and wind turbines
- Transmission, subtransmission and distribution lines and substations
- Mitigative and enhancement measures (fish ladders, recreational and tourist sites, etc.)
- Stabilization and restoration (reforestation)
- Vegetation control and protection of farmland

Comprehensive studies of the urban environment: Montreal, a city of two million



Archipel project. Integration of multiple data: St. Lawrence Seaway, recreational areas, cycle paths, protection of embankments, regulation of the St. Lawrence and Ottawa rivers, development of beaches and parks, water treatment, etc.



New spillway at the Rivière des Prairies power station.

Enhancement of a hydroelectric development for recreational purposes and integration into the built environment: fishpass, riverside park, fishing pier, cycle path, picnic area and playground.

- Water resources: supply, purification, irrigation
- Air quality
- Noise control
- Development strategies
- Development plans

Macro-studies

Macro-studies (or comprehensive studies) form the basis for development strategies and plans. Applying the concepts of versatility and enhancement to macro-studies optimizes a facility by permitting integrated and efficient use of the environment's other resources.

Following are some examples of this type of study.

- The Grande Baleine project in northern Québec, where the Environment group earned an international reputation for the originality, scope and quality of its work.
- The Bamakou-Ségou project in Mali, where the team's expertise translated into efficient, economical solutions.
- The Archipel project in the heart of Montreal, where the development of all water resources was integrated into one comprehensive plan.
- The Three Gorges project in China, where the socio-economic impact of the dam is related to the relocation of hundreds of thousands of people; the physical impact of this shift must be studied at the same time as the hydrological

Data processing applied to comprehensive studies

Inventory software on micro-computer: a flexible and efficient tool.

Diagram of Lac Saint-Louis: bidimensional grid of a body of water.

Satellite image of the island of Montreal: the Archipel project takes all bodies of water into account.

modifications downstream from the dam.

Sectorial studies

Sectorial studies are used to find solutions to specific problems or situations. Over the years, the team has developed and perfected a wide range of methods and tools for pinpointing the right solution.

Here are some examples of sectorial studies.

- Restoration and reforestation in the James Bay region of northern Québec.
- Vegetation control around Hydro-Québec installations, especially power lines.
- Formulation of standards for drinking water supply and quality control, especially in remote regions.
- Cost/benefit analyses of projects, alternatives or mitigative measures.

Hydrodynamic conditions: currents.

Diagram of biological criteria.

Computer-aided cartography.

Interventions in a variety of environments

One remarkable feature of the group's studies is the diversity of the environments in which they are conducted.

Macro-studies are often linked with large-scale projects (dams, dikes, hydroelectric generating stations) which, in Québec, are mostly located in remote or northern regions, such as the La Grande, Ungava Bay, Lac de Baleine development, northern Quebec coastal, Fort Rupert, Shore of the St. Lawrence. In these cases, the [illegible] of electric power stations [illegible] ideologies.

Studies [illegible] a different [illegible] because the issues are closely [illegible] human, economic and social [illegible] of the communities affected. For this type of project, which may take place in an urban, suburban or rural area (Bamakou-Ségou in Mali; Archipel and Rivière-des-Prairies in Montreal; and all the substations and lines in the metropolitan areas around Montreal), a very [illegible] elements, specific to [illegible] must be taken into consideration if the project is to [illegible] integrated into [illegible].

Detailed studies of forested and agricultural areas

Selective land clearing protects a white-tailed deer yard on the route of two 735 kV transmission lines.

Preservation of agricultural land: an agreement concluded with the Union des producteurs agricoles du Québec sets out the basic criteria for the location, construction and maintenance of power lines.

The role of irrigation ditches: reinforcement of embankments, protection of agricultural land, drainage and water supply.

Teams of specialists working together

The Environment group brings together 45 professionals with advanced university training and extensive field experience. Although they represent a cross-section of the natural and social sciences, whenever necessary the group also retains the services of consultants or foreign experts to ensure the highest possible level of expertise.

Multidisciplinary teams

The complexity of the environment, when added to the complexity of the project, makes it important to be able to count on the knowledge of specialists in the various fields involved. For some projects, the Environment group joins forces with larger teams: it then collaborates on planning, engineering, construction or operations with specialists from these disciplines.

Ichthyological surveys.

Lake Massawipi region of Québec: the elements studied include bodies of water, relief, landscape, towns, agricultural lands, wooded areas and roads.

Varied and complementary functions

The Environment group has researchers, consultants and project leaders who manage or coordinate work groups or research teams.

Researchers draw up research programs and develop the standards and methods needed to understand and evaluate the biophysical and human environment as well as the impact of a project. After the laboratory phase, they apply the results to scale models or prototypes. Field validation is used to complete the results, which are then applied to the project itself.

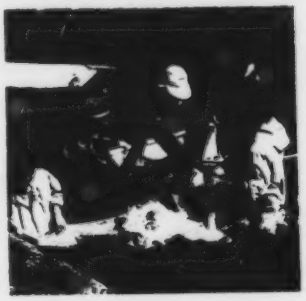
For example, for the Archipel feasibility studies, two models, each representing more than 10 000 m², were used to study the currents, ice movements and water mix in the St. Lawrence. The results helped to determine the specifications for the proposed facilities.

The consultants' role within the team is to make sure the standards and methods of their areas of specialization are followed: they identify supervision requirements and coordinate activities related to their fields.

Ecological follow-up at James Bay after completion of the major work.

Meteorological surveys.

Salmon swimming up the Mitis River to spawn are caught and transported upstream, beyond the dam blocking their path.



On a multidisciplinary team, the project leader directs environmental studies and work: he coordinates all the areas of specialization and oversees the production of impact study reports. He serves as a liaison between the Environment group and the client, and must be able to show the client that all the environmental protection and enhancement requirements in the group's mandate have been met.

Areas of expertise

The Environment group encompasses a vast range of knowledge, which can be divided into three main fields.

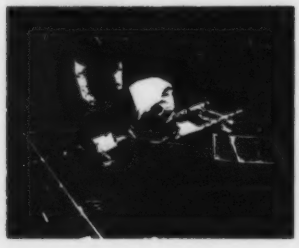
Biophysical sciences: agronomy, biology, chemistry, forestry, civil engineering, electrical engineering, environmental engineering (noise, air quality, water quality, etc.), geology, geomorphology, hydrogeology, hydrology and physics.

Social sciences: land use, archeology, law, economics, ethnology, geography, philosophy, sociology and urban planning.

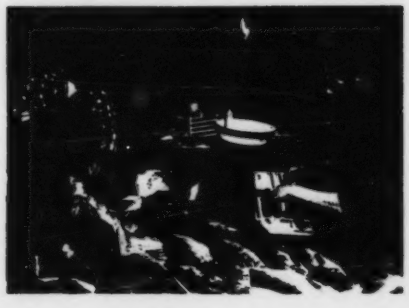
Management sciences: library science, cartography, cost control, estimating, management, modelling, programming and remote sensing.

Archeological inventory on Amerindian lands.

Loup-Marin River: Each year, the reservoir at the Outardes 2 power station is stocked with several thousands of lake Atlantic salmon fry.



Ichthyology laboratory in the field.



Saint-Thomas-de-Joliette: mitigation of the impact on agriculture. Two lines built in 1910 and 1920 will be reconstructed between sandy cultivated soil and wooded black soil.

Hydro-Québec's ***Environment group*** *offers a wealth of expertise and experience – whether in consulting for or actually performing environmental studies and projects – to ensure that decisions and projects are compatible with environmental balance and enhancement.*

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